Patent claims:

1. A transport container for keeping frozen material (17) chilled, in particular frozen biological tissue samples or cell cultures, with an insulation (6) which encloses an insulating chamber (5), with an inner container (2, 30, 44, 70) which is removably arranged in the insulating chamber (5) and receives the frozen material (17) in a chamber (15, 16; 31, 32; 46, 47, 74), and with a refrigerant (15', 32', 47', 71') which gives off cold by phase transformation, characterized in that at least one chilling chamber (16, 31, 46, 74) for the material (17) and at least one refrigerant chamber (15, 32, 47, 71) which is separate from the chilling chamber (16, 31, 46, 74), contains the refrigerant and is permanently hermetically sealed are provided, in that a refrigerant (15', 32', 47', 71') with a solid/liquid phase transition in the temperature range from -15° to -100°C is provided and in that the insulation (6) is a superinsulation with a coefficient of thermal conductivity λ of $\leq$ 0.01 W/m K.

2. The transport container as claimed in claim 1, characterized in that it is surrounded by a chilling jacket (77, 80) with a jacket chamber (77) which contains a refrigerant (78') with a solid/liquid phase transition in the temperature range from 0 to -15°C and is shielded from the outside by means of an insulating jacket (80) comprising a superinsulation with a coefficient of thermal conductivity λ of $\leq$ 0.01 W/m K.

3. The transport container as claimed in claim 1 or 2, characterized in that the refrigerant chamber (15, 32, 47, 71) is formed like the chilling chamber

(16, 31, 46, 74) in the inner container (2, 30, 44, 70).

4. The transport container as claimed in one of claims 1 to 3, characterized in that at least one additional refrigerant container (3, 4; 37, 55) with a refrigerant chamber (24, 38, 57) is provided for arrangement in the insulating chamber (5), which additional container likewise has a filling opening (25, 33) which is permanently hermetically sealed after the introduction of refrigerant (24', 38', 57').

5. The transport container as claimed in one of claims 1 to 4, characterized in that the inner container (2, 30, 44, 70) and/or the additional container (3, 4, 37, 55) consist of high-grade steel, titanium or a titanium alloy or of aluminum or of a low-temperature resistant plastic.

6. The transport container as claimed in one of claims 1 to 5, characterized in that the filling opening (20, 25, 33) for the refrigerant (15', 32', 47') is welded closed.

7. The transport container as claimed in one of claims 1 to 6, characterized in that the filling opening (33) for the refrigerant (15', 32', 47') is closed by a stopper (21, 34, 48, 58, 62).

8. The transport container as claimed in claim 7, characterized in that the stopper (34, 48, 58, 62) is fitted by means of heat shrinkage with a press fit.

9. The transport container as claimed in claim 7 or 8, characterized in that the filling opening (20, 25)

is closed on the inside by a screw stopper (21) and welded closed on the outside.

10. The transport container as claimed in one of claims 7 to 9, characterized in that the filling opening (33) tapers conically and is closed by a conical stopper (34, 62).

11. The transport container as claimed in one of claims 7 to 10, characterized in that the stopper (34, 62) is enclosed by a seal (36) of an amalgam-forming metal such as copper, silver or gold.

12. The transport container as claimed in claim 11, characterized in that the seal (36) is applied as an electrolytic coating to the stopper (34, 62) and/or the stopper seat.

13. The transport container as claimed in one of claims 10 to 12, characterized in that a stopper (62) with a rotary attachment (63) is provided and the stopper (62) is ground into the conical filling opening (33) by rotation.

14. The transport container as claimed in one of claims 6 to 13, characterized in that the closure (62, 63) of the filling opening (33) is removed on the outside as far as a machining surface (66, 67), which terminates flush with the surface (68) of the housing (13, 30, 45) of the refrigerant chamber (15, 32, 47).

15. The transport container as claimed in one of claims 1 to 14, characterized in that the inner container (2, 30) has a double-walled hollow cylinder comprising an inner wall and an outer wall and also a bottom at one end and an annular wall at the

other end, the refrigerant chamber (15, 32) being formed between the spaced-apart cylinder walls, the annular wall and the bottom and the chilling chamber (18, 31) being centrally arranged and delimited by the inner wall and the bottom.

16. The transport container as claimed in claim 15, characterized in that the bottom of the inner container (2) is also of a double-walled configuration and the refrigerant chamber (15) is formed as a cup.

17. The transport container as claimed in claim 15 or 16, characterized in that the permanently sealed filling opening (20) for the refrigerant (15') is provided centrally in the bottom of the inner container (2).

18. The transport container as claimed in one of claims 1 to 14, characterized in that a number of refrigerant chambers (47) are provided in the form of individual axial bores in a cylinder block (45).

19. The transport container as claimed in claim 18, characterized in that the refrigerant chambers (47) are arranged in the form of a ring around at least one chilling chamber (46), which is likewise configured as an axial bore in the cylinder block (45) which forms the inner container (64).

20. The transport container as claimed in one of claims 1 to 19, characterized in that the inner wall of the inner container (2, 30, 44) has a thread for a screw cover (14) or screw stopper (42, 51) closing the chilling chamber (16, 31, 46).

21. The transport container as claimed in one of claims 1 to 20, characterized in that the chilling chamber (16, 31, 46) has an adapted length for receiving a sample container (18) and an additional container (3, 4, 37, 55) respectively above and/or below the sample container (18).

22. The transport container as claimed in claim 21, characterized in that the additional containers (37, 55) can be screwed with their end faces to make firm contact with the inner container (30, 44), for which purpose they have a central threaded stub (39, 59) and the inner container (30, 40) has at the end faces corresponding threaded bores (40, 41, 60, 61).

23. The transport container as claimed in claim 21 or 22, characterized in that insulating stoppers (28) which can be exchanged for the additional containers (3, 4, 37, 55) are provided.

24. The transport container as claimed in one of claims 1 to 23, characterized in that the insulation (6) is formed as a cup with a central insulating chamber (5) which is adapted to the inner container (2, 30, 44) and can be closed by means of the insulating closure (8).

25. The transport container as claimed in one of claims 1 to 24, characterized in that the insulation (6) is surrounded by a rigid protective tube (9), the ends of which are respectively closed by a screw cover (11, 12).

26. The transport container as claimed in one of claims 1 to 25, characterized in that a refrigerant (15',

32', 47', 71') which melts/solidifies at a temperature of ≤ -30°C is provided.

27. The transport container as claimed in one of claims 1 to 26, characterized in that a refrigerant (15', 32', 47', 71') which melts/solidifies at a temperature of ≥ -85°C is provided.

28. The transport container as claimed in one of claims 1 to 27, characterized in that the refrigerant (15', 32', 47', 71') is mercury.

29. The transport container as claimed in one of claims 1 to 27, characterized in that the refrigerant (15', 32', 47', 71') is an organic substance such as for example octane, 1-hexanol, 2-hexanone, hexanal, pyridine, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, chlorobenzene or a mixture of organic substances.

30. The transport container as claimed in claim 29, characterized in that the refrigerant (15', 32', 47', 71') additionally contains water as a mixing component.

31. The transport container as claimed in claim 30, characterized in that the refrigerant (15', 32', 47', 71') is a mixture of diethylene glycol with water.

32. The transport container as claimed in one of claims 1 to 31, characterized in that the heat of melting of the refrigerant (15', 32', 47') is at least 50 J/ml.

33. The transport container as claimed in one of claims 1 to 32, characterized in that the intended

superinsulation has a coefficient of thermal conductivity λ of $\leq$ 0.005 W/m K, preferably 0.002 W/m K.